WATER VALUE IN POWER GENERATION

Experts distinguish water use and consumption

Having enough water available for municipal and agricultural needs is often discussed; however, having the water needed to generate electric power and the electricity needed to treat and transport water is a struggle all its own.

According to *Water for Texas 2012*, the state water plan, steam-electric power generation demand in 2010 was 733,179 acre-feet of water per year and is projected to increase to 1,620,411 by 2060; however, that amount only accounts for 7.4 percent of 2060 total water demand. Steam-electric falls fourth in the list of six categories, with municipal (38.3 percent), irrigation (38.1 percent) and manufacturing (13.1 percent) demands leading, followed by livestock (1.7 percent) and mining (1.3 percent) demands.

Water use versus water consumption

When talking about water for power generation, two important terms must be explained and understood: water use and water consumption, said Dr. Susan Stuver, research scientist with the Texas A&M Institute of Renewable Natural Resources and Texas Water Resources Institute.

"If you're using water and putting it back where it came from, it's water use," Stuver said. "A power plant is not consuming millions of gallons; it just needs (the water) once and then puts it back, and keeps using the same water over and over again.

"Water is drawn from the reservoir, used to cool the power plant and is then returned to the reservoir where it can therefore be used for other activities such as habitat for wildlife or recreation."

On the other hand, she continued, water consumption means that water is removed from the water system and becomes unavailable for other uses; it either becomes waste or must undergo treatment if it is to be reused, or in the case of irrigation, it is consumed by plants.

"It is a common mistake to lump water use and water consumption together," Stuver said. "We should always make the careful distinction because reducing water consumption and reducing water use will have very different results."

Cooling technology options

The amount of water a power plant uses depends on the type of plant and its cooling system. The cooling technologies currently used in Texas thermal power plants include once-through cooling and wet cooling tower systems, which both use water to condense steam, and dry cooling systems that use air to condense steam. Some cooling systems use more water, but consume less, while others use less water, but consume more.

For example, dry cooling systems use less water and consume less water than either of the wet cooling systems. However, according to experts, they may not be as effective in certain environments or may not be the technology of choice for a variety of reasons.

With wet cooling towers, the amount of water used will vary by plant based largely on the amount of power produced and the quality of the steam used, said Kent Zammit, senior program manager at Electric Power Research Institute (EPRI). EPRI is an independent, nonprofit organization that ⇨

In Grimes County, the sun sets over Gibbons Creek Reservoir, the cooling water supply for an adjacent power plant. Photo by Leslie Lee.

performs research, development and demonstrations in the electricity sector for the benefit of the public.

"For example, using once-through cooling would withdraw more water but generally consumes less than half of the water compared to using wet cooling towers," Zammit said. "Using dry cooling would virtually eliminate any water use for cooling."

"Having a variety of technologies to rely on is a smart choice," Stuver said. "Dry cooling is a great technology for places where the ambient temperature stays relatively cool since dry cooling technologies can only 'cool' to the ambient temperature around them.

"Places in deep South Texas can get to temperatures of 115 degrees Fahrenheit in the summer months and therefore are not optimal for dry cooling."

While retrofitting existing power plants to wet cooling towers or dry cooling systems has been suggested, that would be extremely expensive and result in unoptimized operating conditions, Zammit said. Such a retrofit would be comparable to changing a 20-year-old car to a hybrid drive system to get better gas mileage—it is technically feasible, he said, but would not make economic sense given the remaining life of the car.

A recent report prepared for EPRI by the Water Conservation and Technology Center, which is part of The Texas A&M University System, stated that Texas power producers who use once-through cooling typically consume less than 1 acre-foot of water per 1,000 megawatt-hours of electricity produced. This is lower than the national average for once-through systems. Wet cooling towers only use approximately 5 percent of the water that once-through systems use, but they consume at least 100 percent more water than a once-through system, since the majority of the heat rejection for wet cooling towers is through evaporation of water.

Conservation at Texas power plants

Because the electric power generation community understands the importance of water, a lot is being done to conserve water at Texas power plants, Zammit said.

For one, renewable energy sources (wind and solar photovoltaic) are being constructed in the state, and these energy sources require no cooling water.

"Renewable energy sources tend to be lower water consumers," he said.

Power plants can also be designed to use nonpotable water like sewage effluent and high-salinity groundwater, he said. In addition, EPRI is researching projects that could become the next generation of water conservation technologies.

Benefits of cooling reservoirs

Some existing plants use once-through cooling with water withdrawn from manmade reservoirs, Stuver said. There are 209 reservoirs in the state of Texas, and a lot of those lakes serve the public as recreational areas for boating, skiing, fishing, camping and more. The reservoirs also provide wetland and riparian habitats for wildlife.

"The power plants are the ones who keep the water in those lakes," she said. "They need a big lake, but let other people use it. Power plants don't contaminate the water, but they cycle it through and then put it back."

"With normal rainfall, reservoir levels can be maintained without much makeup water," Zammit said. "But in drought conditions, additional water may be needed to maintain the reservoir level at a minimum level necessary for operation of the power plant."

The Calaveras Lake near San Antonio is a good example—the 3,624-acre lake offers fishing, boating and watersport opportunities and a park including a nature trail, campsites, shaded picnic tables, a fishing pier and a boat ramp, Stuver said. It is also a great bird-watching location.

"This lake is actually a power plant cooling reservoir that was formed in 1969 by the construction of a dam to provide a cooling pond for a complex of power plants that supply additional electricity to the city of San Antonio," she said. "The Calaveras reservoir has a tremendous economic impact on the area primarily from the large populations of threadfin shad and large-mouth bass fish that grow well in the warm, nutrient-rich waters."

Texans also benefit from the water used for power generation in multiple ways. Reliable generation of electricity is necessary for pumping water to cities and farms and for treating water and sewage. Electricity powers nearly everything residents do. It is particularly important in providing heating or cooling and providing power to business and medical equipment. In short, electricity drives the state's economy and resulting quality of life.

Renowned research

Researchers at Texas A&M University are studying water consumption in various industries.

"Texas A&M has world-renowned leaders that come together both from the water conservation and petroleum and electrical engineering fields," Stuver said. "We take new discoveries to the next level by converting those discoveries into technologies that we commercialize to stimulate the economy.

This has led to strong partnerships with the power generation industry, power production industry, oil and gas industry, government and policymakers as well as other universities."

The Water Conservation and Technology Center has just finished the water consumption study for power generation mentioned throughout this article and is preparing to begin a new study in 2013 on water consumption in lignite mining, she said. The Texas Water Resources Institute and Texas A&M Institute of Renewable Natural Resources are working with the Global Petroleum Research Institute to reduce the environmental footprint of hydraulic fracturing through water conservation strategies, wastewater treatment technologies and innovations in desalination.

Benefits of water consumption

While used cooling water can easily be reused, power plants do consume water. However, this consumption serves an important function in the electric generation process, experts say.

Stuver said water consumption for power generation and power production, such as drilling and fracturing, is important, just as is the water needed to grow our food. It is, of course, important to save water where we can, she said, but not at a cost that will either make electricity unaffordable or lead to rolling blackouts due to not enough power being generated to meet our demands.

"In other words, we should always bear in mind the bigger picture," Stuver said.

For more information, visit *txH2O* online at *twri.tamu.edu/publications/txH2O*.

Gibbons Creek Reservoir serves as the cooling water supply for an adjacent power plant and as a recreational lake. Photo by Leslie Lee.